DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]What is called extensive dynamic range CCD (Charge Coupled Device) with a large dynamic range [as opposed to / about a solid state camera / an optical input in especially this invention] It is related with a solid state camera.
[0002]
[Description of the Prior Art]After the signal charge which photoelectric conversion was carried out to matrix form, and was accumulated in it in each pixel (light sensing portion) by which two-dimensional arrangement was carried out overflows with CCD solid state cameras from a pixel, Since it becomes fixed signal outputting based on this signal charge, the signal output corresponding to the incident light quantity more than the saturation level of a pixel is not obtained, therefore the dynamic range to an optical input is narrow.
[0003]Two kinds of pixels from which sensitivity differs as shown in drawing 18 in order to expand this dynamic range, For example, adjoin perpendicularly and the high sensitivity pixel 101 and the low sensitivity pixel 102 are arranged by turns, After hanging a limiting circuit within a pixel about the signal charge of the high sensitivity pixel 101, it reads to the vertical transfer register 103, Vertical transfer is carried out after mixing the signal charge of the high sensitivity pixel 101, and the signal charge of the low sensitivity pixel 102 within the register 103 concerned, Furthermore, horizontal transfer is carried out with the horizontal transfer register 104, the charge detector 105 is supplied, and after changing into an electrical signal here, there is a solid state camera of composition of having made it output via the buffer 106 (for example, refer to JP,3-117281,A).
[0004]Since a limiting circuit will start the signal charge of the high sensitivity pixel 101 if it becomes in this CCD solid state camera more than a constant rate with incident light quantity, it is mixing the signal charge of this high sensitivity pixel 101, and the signal charge of the low

sensitivity pixel 102, The input-output behavioral characteristics of the polygonal line approximation shown in drawing 19 are obtained, and extensive dynamic range-ization is realized by this.

[0005]

[Problem(s) to be Solved by the Invention]However, in the high sensitivity pixel 101, with the conventional CCD solid state camera of the above-mentioned composition which hung the limiting circuit for every pixel. Actually, the overflow characteristic varies for every pixel, and since the nonuniformity of the saturation charge quantity Qs of each pixel is large, as shown in drawing 20, offset arises in the input-output behavioral characteristics of polygonal line approximation. Therefore, when it was the incident light quantity that the high sensitivity pixel 101 is saturated, there was a problem that a fixed pattern noise (nonuniformity of a fixed pattern) occurred in a picture according to the nonuniformity of the saturation charge quantity Qs which is each pixel being large.

[0006]Then, an object of this invention is to provide the solid state camera which enabled expansion of the dynamic range, without generating the fixed pattern noise resulting from the nonuniformity of the saturation charge quantity Qs of each pixel.

[0007]

[Means for Solving the Problem]Two or more light sensing portions by which consisted of several light-receiving fields where each sensitivity differs while a solid state camera by this invention was divided into at least two by channel stopping area and having an opening independently respectively, and two-dimensional arrangement was carried out at matrix form, Inside of a signal charge which was arranged for every vertical file of two or more of these light sensing portions, and was read from each of two or more light-receiving fields for every light sensing portion, Two or more vertical transfer registers which mix and carry out vertical transfer of the signal charges of a light-receiving field of the sensitivity with same adjacent light sensing portion, Two or more horizontal transfer registers which carry out horizontal transfer with these two or more vertical transfer registers in response to the fact that [a signal charge of a light-receiving field where sensitivity transmitted in order differs] independently, Two or more charge detectors which detect a signal charge transmitted with these two or more horizontal transfer registers, and are transformed into an electrical signal, An output signal based on signal charges other than a signal charge of a light-receiving field of figure of merit is clipped at least among each output signal of two or more of these charge detectors, and it has composition provided with a digital disposal circuit which adds and outputs this clipped signal and an output signal based on a signal charge of a light-receiving field of other sensitivity.

[0008]In a solid state camera of the above-mentioned composition, charge quantity by which photoelectric conversion is carried out in each light-receiving field to the same incident light because sensitivity of two or more light-receiving fields of each light sensing portion differs

respectively differs. Each signal charge of two or more light-receiving fields is read from these light sensing portions to a vertical transfer register for every light sensing portion. Post-vertical transfer of the signal charges of a light-receiving field of the sensitivity with same light sensing portion that adjoins each other among this read signal charge is mixed and carried out within a vertical transfer register, Corresponding to a light-receiving field where sensitivity differs, it can distribute to two or more more horizontal transfer registers, horizontal transfer is carried out independently, and it is changed into an electrical signal by a charge detector. And in a digital disposal circuit, an output signal based on signal charges other than a signal charge of a light-receiving field of figure of merit clips at least among each output signal of a charge detector, and it is added with an output signal based on a signal charge of a light-receiving field of sensitivity besides after an appropriate time.

[0009]Two or more light sensing portions by which consisted of several light-receiving fields where each sensitivity differs while other solid state cameras by this invention were divided into at least two by channel stopping area and having an opening independently respectively, and two-dimensional arrangement was carried out at matrix form, Inside of a signal charge which was arranged for every vertical file of two or more of these light sensing portions, and was read from each of two or more light-receiving fields for every light sensing portion, Two or more vertical transfer registers which mix and carry out vertical transfer of the signal charges of a light-receiving field of the sensitivity with same adjacent light sensing portion, Two or more horizontal transfer registers which carry out horizontal transfer with these two or more vertical transfer registers in response to the fact that [a signal charge of a light-receiving field where sensitivity transmitted in order differs] independently, Signal charges other than a signal charge of a light-receiving field of figure of merit are clipped at least among signal charges transmitted with these two or more horizontal transfer registers, and it has composition provided with an outputting part which mixes and outputs this clipped signal charge and a signal charge of a light-receiving field of other sensitivity.

[0010]In other solid state cameras of the above-mentioned composition, like a case of a previous solid state camera, Inside of a signal charge read from each of two or more light-receiving fields for every light sensing portion, The signal charges of a light-receiving field of the sensitivity with same adjacent light sensing portion can distribute corresponding to a light-receiving field which was mixed within a vertical transfer register and where post-vertical transfer is carried out and sensitivity differs in two or more more horizontal transfer registers, and horizontal transfer is carried out independently. And in an outputting part, signal charges other than a signal charge of a light-receiving field of figure of merit clip at least among signal charges by which horizontal transfer was carried out, and a signal charge of a light-receiving field of sensitivity besides after an appropriate time is mixed.

[0011]

[Embodiment of the Invention]Hereafter, it explains in detail, referring to drawings for an embodiment of the invention. Drawing 1 is an outline lineblock diagram showing one embodiment of this invention. In drawing 1, two-dimensional arrangement of two or more light sensing portions (pixel) 1 which change and accumulate incident light in the signal charge of charge quantity according to the light volume is carried out at matrix form. These light sensing portions 1 are constituted by the channel stopping area 11 by the two light-receiving fields 12a and 12b divided into two.

[0012]As shown in drawing 2, the openings 13a and 13b for incorporating incident light are independently formed in these two light-receiving fields 12a and 12b. Each effective area product Sa of the openings 13a and 13b and Sb are set up differ mutually, for example, become Sa<Sb. Since the light volume which the direction of the large light-receiving field 12b of an effective area product incorporates to the same incident light by this increases, in the light-receiving field 12b, sensitivity becomes high rather than the light-receiving field 12a. Sensitivity differences will become still bigger by arranging the lens 14 on chip only on the light-receiving field 12b by the side of high sensitivity.

[0013]In this example, in order to change the sensitivity of the two light-receiving fields 12a and 12b, changed each effective area product Sa of the openings 13a and 13b, and Sb, and had composition which arranges the lens 14 on chip only on the one where sensitivity is still higher, but. It is also possible for arranging the lens 14 on chip only on one side to give sensitivity differences between the two light-receiving fields 12a and 12b as the effective area product Sa and Sb are changed. It is possible to give sensitivity differences to the two light-receiving fields 12a and 12b by arranging a colored filter on the two light-receiving fields 12a and 12b, changing the transmissivity of each colored filter, or changing the thickness of the cascade screen on the two light-receiving fields 12a and 12b, and changing transmissivity etc.

[0014]The vertical transfer register 2-1 of n book - 2-n are allotted for every vertical file of the to each light sensing portion 1 of the above-mentioned composition. The vertical transfer register 2-1 - the plane pattern of 2-n are shown in drawing 3, and the X-X' line section is shown in drawing 4, respectively. In drawing 3 and drawing 4, the channel stopping area 22 is formed along with the transfer channel 21. The transfer electrodes 24, 25, and 26 which consist of polysilicon (1Poly, 2Poly, 3P oly) of the 1st layer, the 2nd layer, and the 3rd layer above the transfer channel 21 via the gate dielectric film (SiO_2) 23, It is repeatedly arranged in the direction of transfer in order of the transfer electrode 24 -> transfer electrode 26 -> transfer electrode 25.

[0015]The vertical transfer register 2-1 of the above-mentioned composition - 2-n are driven, for example with the vertical transfer clocks phiV1 to phiV6 of six phases. The vertical transfer clocks phiV1 to phiV6 of these six phases make a pair 2 pixels which adjoin each other in the direction of vertical transfer about the three transfer electrodes 24, 26, and 25 provided

corresponding to the one light sensing portion 1, and are given these six transfer electrodes as one unit.

[0016]Namely, to the transfer electrode 24 of the 1st layer corresponding to one light sensing portion 1 the vertical transfer clocks phiV1 of a plane 1 eye, The vertical transfer clocks phiV2 of eye two phases are impressed to the transfer electrode 26 of the 3rd layer, and the vertical transfer clocks phiV3 of a three-phase-circuit eye are impressed to the transfer electrode 25 of the 2nd layer, respectively, The vertical transfer clocks phiV5 of eye five phases are impressed to the transfer electrode 26 of the 3rd layer, and the vertical transfer clocks phiV6 of eye six phases are impressed to the transfer electrode 24 of the 1st layer corresponding to the light sensing portion 1 of another side for the vertical transfer clocks phiV4 of eye four phases at the transfer electrode 25 of the 2nd layer, respectively. These vertical transfer clocks phiV1 to phiV6 take a ternary level, and can read a signal charge now by any electrode of the three transfer electrodes 24, 25, and 26 by this.

[0017]In this vertical transfer register 2-1 - 2-n, the signal charges of the light-receiving field of the sensitivity with same light sensing portion that adjoins each other among the signal charges read for every light sensing portion sequentially from each of the two light-receiving fields 12a and 12b are mixed. At this time, each signal charge of the light-receiving field where sensitivity differs is arranged by turns in the vertical transfer register 2-1 - 2-n. And they are transmitted perpendicularly, the vertical transfer register 2-1 - 2-n shifting each mixed signal charge in order in a part of horizontal blanking period. Concrete operation of read-out of this signal charge, mixing, and vertical transfer is explained in detail later.

[0018]Corresponding to the two light-receiving fields 12a and 12b where sensitivity differs ahead of the direction of transfer of the vertical transfer register 2-1 - 2-n, the two horizontal transfer registers 3 and 4 are arranged. These two horizontal transfer registers 3 and 4 are driven by the horizontal transfer clock phiH1 of two phases, and phiH2, The signal charge for one line of the light-receiving field where the sensitivity transmitted sequentially from the vertical transfer register 2-1 - 2-n differs is received independently, and it transmits horizontally one by one in the horizontal scanning period after a horizontal blanking period.

[0019]For example, the vertical transfer register 2-1 - the horizontal transfer register 3 by the side of 2-n, Transmitting in order the signal charge for 2 pixels produced by mixing the signal charges of the light-receiving field 12a of the low sensitivity of the adjacent light sensing portion 1, another horizontal transfer register 4 transmits in order the signal charge for 2 pixels produced by mixing the signal charges of the light-receiving field 12b of the high sensitivity of the adjacent light sensing portion 1. The distribution of a signal charge to these two horizontal transfer registers 3 and 4 is performed by the distribution transfer gate 5 allotted among both the horizontal transfer registers 3 and 4.

[0020]That is, as shown in drawing 5, the signal charge transmitted to the vertical transfer

register 2-1 - one [2-n to] horizontal transfer register 3 has structure moved to the horizontal transfer register 4 of another side through the channel regions 51 controlled by the distribution transfer gate 5. Opening and closing control of the distribution transfer gate 5 is carried out by distribution gate pulse phiHHG. The channel stop part 52 was formed in the both sides of the channel regions 51, and the charge transfer from the horizontal transfer register 3 corresponding to it to the horizontal transfer register 4 is prevented.

[0021]In drawing 5, O seal specifically shows the signal charge about the light-receiving field 12a of low sensitivity, When - seal shows the signal charge about the light-receiving field 12b of high sensitivity, if moved from the vertical transfer register 2-1 - 2-n to the horizontal transfer register 3, in the horizontal transfer register 3, horizontal transfer of signal-charge O will be carried out as it is. On the other hand, if moved from the vertical transfer register 2-1 - 2-n to the horizontal transfer register 3, signal-charge - is distributed further, it will be moved to the horizontal transfer register 4 by the transfer gate 5 via the channel regions 51, and horizontal transfer will be carried out as it is in the horizontal transfer register 4.

[0022]The charge detectors 6 and 7 of floating diffusion amplifier composition are formed in the end of the destination of the horizontal transfer registers 3 and 4, respectively. With the horizontal transfer registers 3 and 4, these charge detectors 6 and 7 detect the signal charge by which horizontal transfer was carried out, and change it into a signal level. These two signal levels are outputted to the exterior as signal output OUT1 and OUT2 via the buffers 8 and 9. Various kinds of timing signals, such as the vertical transfer clocks phiV1 to phiV6 of six phases, the horizontal transfer clock phiH1 of two phases, phiH2, and distribution gate pulse phiHHG, are generated by the timing generator 10.

[0023]Signal output OUT1 is a signal level based on the signal charge of the light-receiving field 12a of low sensitivity among two signal output OUT1 and OUT2, and signal output OUT2 is a signal level based on the signal charge of the light-receiving field 12b of high sensitivity. This signal output OUT1 and OUT2 are supplied to the external digital disposal circuit 30. An example of the concrete circuitry of this digital disposal circuit 30 is shown in drawing 6.

[0024]In drawing 6, after sample hold of signal output OUT1 is carried out in the sample hold (S/H) circuit 31, in the slicing circuit 32, it is sliced with the predetermined slice level E1. The output signal of this slicing circuit 32 is amplified with the video amplifier 33, and serves as one input of the adding machine 34. Sample hold of signal output OUT2 is carried out in the sample hold circuit 35, and after clipping in the predetermined clip level E2 in the clipping circuit 36, it becomes an input of another side of the adding machine 34. The adding machine 34 adds both input signals, and makes them a video output signal. The characteristic of a video output signal to incident light quantity is shown in drawing 7.

[0025]As mentioned above, after clipping the output signal based on the signal charge of the light-receiving field 12b of high sensitivity in the predetermined clip level E2, By adding with the

output signal based on the signal charge of the light-receiving field 12a of the low sensitivity which was sliced with the predetermined slice level E1, and was amplified with the video amplifier 33, and having made it derive as a video output, Since a clip is hung with the common clip level E2 to the output signal based on the signal charge of the light-receiving field 12b of high sensitivity, it can control that originate in the characteristic variation between pixels and the nonuniformity of a fixed pattern occurs in a picture.

[0026]The CCD solid state camera concerning this embodiment of composition of having divided each light sensing portion 1 into two, and having arranged the light-receiving field 12a of low sensitivity and the light-receiving field 12b of high sensitivity by turns in the direction of vertical transfer in the array constitution of a pixel, As shown in drawing 18, it is notionally [as the conventional CCD solid state camera of composition of having arranged the high sensitivity pixel 101 and the low sensitivity pixel 102 by turns in the direction of vertical transfer] the same. However, in this embodiment, composition which divided the one light sensing portion (pixel) 1 in the channel stopping area 11 is made into one feature.

[0027]Thus, micro processing of a pixel becomes possible by dividing the one light sensing portion 1 in the channel stopping area 11, and taking the composition which has arranged the light-receiving field 12a of low sensitivity, and the light-receiving field 12b of high sensitivity by turns in the direction of vertical transfer. Thereby, multi-pixel-izing and a miniaturization of a CCD solid state camera can be attained.

[0028]Although vertical resolution falls to a half by having mixed the signal charges of the light-receiving field which have the same sensitivity in 2 pixels (light sensing portion) which adjoins each other in the direction of vertical transfer, conventional field read-out and frame read-out can be realized.

[0029]being hereafter engaged in read-out of the signal charge from the two light-receiving fields 12a and 12b, mixing, and concrete operation of vertical transfer -- field read-out and frame read-out -- a case -- dividing -- carrying out -- explaining . In the vertical transfer register 2-1 shown in drawing 3 - 2-n, the vertical transfer clocks phiV1 to phiV6 of six phases take a ternary level, as point ** was carried out. That is, the ternary of a high level (it is hereafter described as "H" level), an intermediate level (it is hereafter described as the "M" level), and a low (it is hereafter described as the "L" level) is taken, and it has composition which a signal charge can read by any electrode of the three transfer electrodes 24, 25, and 26 by this.

[0030]First, operation of the odd number field in field read-out is explained with reference to the timing chart of drawing 8 based on the explanatory view of drawing 9 of operation. First, since the potential under the transfer electrode 25 of the 2nd layer will become deep in 2-pixel adjacent each in a vertical blanking period if the vertical transfer clocks phiV3 and phiV6 are set to "H" level, The signal charge (O seal shows among a figure and suppose that it is the same as that of the following) accumulated in the light-receiving field 12b of high sensitivity is

read under the transfer electrode 25 (t=t1). At this time, both the vertical transfer clocks phiV1, phiV2, phiV4, and phiV5 are on the "L" level.

[0031]Then, the vertical transfer clocks phiV3, phiV4, and phiV5 change on the "L" level through the "M" level in order. That is, the vertical transfer clocks phiV3 change on ""M" level from H" level, and change on a fixed time of after "L" level further. Next, the vertical transfer clocks phiV4 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV3, and change on a fixed time of after "L" level further. Then, the vertical transfer clocks phiV5 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV4, and change on a fixed time of after "L" level further.

[0032]Thus, when the vertical transfer clocks phiV3, phiV4, and phiV5 change on the "L" level via the "M" level in order, vertical transfer of the signal charge under the transfer electrode 25 in which the vertical transfer clocks phiV3 were impressed is carried out. Since the vertical transfer clocks phiV6 continued and it was in the "M" level at this time, when the vertical transfer clocks phiV5 change on "M" "L" level from a level (t=t2), The signal charge transmitted from under the transfer electrode 25 in which the vertical transfer clocks phiV3 were impressed is moved under the transfer electrode 25 in which the vertical transfer clocks phiV6 were impressed, and the signal charges by the side of high sensitivity are mixed in 2 pixels which therefore adjoins each other.

[0033]Next, since the potential under one 2-pixel transfer electrode 26 of the 3rd layer and the transfer electrode 24 of the 1st layer of another side will become deep if the vertical transfer clocks phiV2 and phiV4 are set to "H" level, The signal charge (x seal shows among a figure and suppose that it is the same as that of the following) accumulated in the light-receiving field 12a of low sensitivity is read under the transfer electrodes 26 and 24 (t=t3). At this time, both the vertical transfer clocks phiV1, phiV3, and phiV5 are in the "L" level, and the vertical transfer clocks phiV6 are on the "M" level.

[0034]Then, the vertical transfer clocks phiV2 and phiV3 change on the "L" level through the "M" level in order. That is, the vertical transfer clocks phiV2 change on ""M" level from H" level, and change on a fixed time of after "L" level further. Next, the vertical transfer clocks phiV3 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV2, and change on a fixed time of after "L" level further.

[0035]Thus, when the vertical transfer clocks phiV2 and phiV3 change on the "L" level via the "M" level in order, vertical transfer of the signal charge under the transfer electrode 26 in which the vertical transfer clocks phiV2 were impressed is carried out. Since the vertical transfer clocks phiV4 continued and it was in the "M" level at this time, when the vertical transfer clocks phiV3 change on "M" "L" level from a level (t=t4), The signal charge transmitted from under the transfer electrode 26 in which the vertical transfer clocks phiV2 were impressed is moved under the transfer electrode 24 in which the vertical transfer clocks phiV4 were impressed, and

the signal charges by the side of low sensitivity are mixed in 2 pixels which therefore adjoins each other.

[0036]In this state, the signal charge of the same light-receiving fields of sensitivity mixed in 2 pixels which adjoins each other in a perpendicular direction, i.e., signal-charge O by the side of high sensitivity and signal-charge x by the side of low sensitivity, will be arranged by turns for every line. Henceforth, it shifts to a line shift period and vertical transfer is performed. And in drawing 1, via the horizontal transfer register 3 and the distribution transfer gate 5 in signal-charge x by the side of low sensitivity, signal-charge O by the side of high sensitivity is moved to the horizontal transfer register 4 by the horizontal transfer register 3 per line, respectively, and horizontal transfer is carried out to it after that.

[0037]Then, operation of the even number field in field read-out is explained with reference to the timing chart of drawing 10 based on the explanatory view of drawing 11 of operation. Since the potential under the transfer electrode 25 of the 2nd layer will become deep in 2-pixel adjacent each in a vertical blanking period if the vertical transfer clocks phiV3 and phiV6 are set to "H" level, The signal charge accumulated in the light-receiving field 12b of high sensitivity is read under the transfer electrode 25 (t=t5). At this time, both the vertical transfer clocks phiV1, phiV2, phiV4, and phiV5 are on the "L" level.

[0038]Then, the vertical transfer clocks phiV6, phiV1, and phiV2 change on the "L" level through the "M" level in order. That is, the vertical transfer clocks phiV6 change on ""M" level from H" level, and change on a fixed time of after "L" level further. Next, the vertical transfer clocks phiV1 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV6, and change on a fixed time of after "L" level further. Then, the vertical transfer clocks phiV2 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV1, and change on a fixed time of after "L" level further.

[0039]Thus, vertical transfer of the signal charge under the transfer electrode 25 in which the vertical transfer clocks phiV6 were impressed is carried out because the vertical transfer clocks phiV6, phiV1, and phiV2 change on the "L" level via the "M" level in order. Since the vertical transfer clocks phiV3 continued and it was in the "M" level at this time, when the vertical transfer clocks phiV2 change on "M" "L" level from a level (t=t6), The signal charge transmitted from under the transfer electrode 25 in which the vertical transfer clocks phiV6 were impressed is moved under the transfer electrode 25 in which the vertical transfer clocks phiV3 were impressed, and the signal charges by the side of high sensitivity are mixed in 2 pixels which adjoins each other in a combination different therefore from the case of an odd number field.

[0040]Next, since the potential under adjacent one 2-pixel transfer electrode 24 of the 1st layer and the transfer electrode 26 of the 3rd layer of another side will become deep if the vertical transfer clocks phiV1 and phiV5 are set to "H" level, The signal charge accumulated in the light-receiving field 12a of low sensitivity is read under the transfer electrodes 24 and 26 (t=t7).

At this time, both the vertical transfer clocks phiV2, phiV4, and phiV6 are in the "L" level, and the vertical transfer clocks phiV3 are on the "M" level.

[0041]Then, the vertical transfer clocks phiV5 and phiV6 change on the "L" level through the "M" level in order. That is, the vertical transfer clocks phiV5 change on ""M" level from H" level, and change on a fixed time of after "L" level further. Next, the vertical transfer clocks phiV6 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV5, and change on a fixed time of after "L" level further.

[0042]Thus, when the vertical transfer clocks phiV5 and phiV6 change on the "L" level via the "M" level in order, vertical transfer of the signal charge under the transfer electrode 26 in which the vertical transfer clocks phiV5 were impressed is carried out. Since the vertical transfer clocks phiV1 continued and it was in the "M" level at this time, when the vertical transfer clocks phiV6 change on "M" "L" level from a level (t=t8), The signal charge transmitted from under the transfer electrode 26 in which the vertical transfer clocks phiV5 were impressed is moved under the transfer electrode 24 in which the vertical transfer clocks phiV1 were impressed, and the signal charges by the side of low sensitivity are mixed in 2 pixels which adjoins each other in a combination different therefore from the case of an odd number field. Henceforth, it shifts to a line shift period and vertical transfer and horizontal transfer are performed like the case of an odd number field.

[0043]Next, operation of the odd number field in frame read-out is explained with reference to the timing chart of drawing 12 based on the explanatory view of drawing 13 of operation. First, since the potential under every other the pixel transfer electrode 25 of the 2nd layer will become deep in a perpendicular direction in a vertical blanking period if the vertical transfer clocks phiV6 are set to "H" level, The signal charge accumulated in the light-receiving field 12b of high sensitivity is read under the transfer electrode 25 at intervals of a pixel (t=t1). At this time, both the vertical transfer clocks phiV1 to phiV5 are on the "L" level.

[0044]Then, the vertical transfer clocks phiV6, phiV1, and phiV2 change on the "L" level through the "M" level in order. That is, the vertical transfer clocks phiV6 change on ""M" level from H" level, and change on a fixed time of after "L" level further. Next, the vertical transfer clocks phiV1 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV6, and change on a fixed time of after "L" level further. Then, the vertical transfer clocks phiV2 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV1, and change on a fixed time of after "L" level further.

[0045]Thus, when the vertical transfer clocks phiV6, phiV1, and phiV2 change on the "L" level via the "M" level in order, vertical transfer of the signal charge under the transfer electrode 25 in which the vertical transfer clocks phiV6 were impressed is carried out. Since the vertical transfer clocks phiV3 were in the "M" level at this time, when the vertical transfer clocks phiV2 change on "M" "L" level from a level (t=t2), The signal charge transmitted from under the

transfer electrode 25 in which the vertical transfer clocks phiV6 were impressed is moved under the transfer electrode 25 in which the vertical transfer clocks phiV3 were impressed, and is accumulated here.

[0046]Next, since the potential under the transfer electrode 26 of the 3rd layer of the pixel of the light-receiving field 12b of the high sensitivity read previously will become deep if the vertical transfer clocks phiV5 are set to "H" level, The signal charge accumulated in the light-receiving field 12a of the low sensitivity of the pixel concerned is read under the transfer electrode 26 (t=t3). At this time, both the vertical transfer clocks phiV1, phiV2, and phiV4 are in the "L" level, and both the vertical transfer clocks phiV3 and phiV6 are on the "M" level.

[0047]Since the potential under the transfer electrode 25 in which the potential and the vertical transfer clocks phiV6 under the transfer electrode 26 in which the vertical transfer clocks phiV5 were impressed were impressed will serve as the level if the vertical transfer clocks phiV5 are set to the "M" level, Signal-charge x read from the light-receiving field 12a of low sensitivity is stored under the transfer electrode 26 and the transfer electrode 25. And if the vertical transfer clocks phiV5 are set to the "L" level, the potential under the transfer electrode 26 will become shallow, and signal-charge x of the light-receiving field 12a of low sensitivity will be stored under the transfer electrode 25 (t=t4).

[0048]In this state, signal-charge O by the side of the high sensitivity read at intervals of a pixel in the perpendicular direction and signal-charge x by the side of low sensitivity will be arranged by turns for every line. Henceforth, it shifts to a line shift period and vertical transfer is performed. And in drawing 1, via the horizontal transfer register 3 and the distribution transfer gate 5 in signal-charge x by the side of low sensitivity, signal-charge O by the side of high sensitivity is moved to the horizontal transfer register 4 by the horizontal transfer register 3 per line, respectively, and horizontal transfer is carried out to it after that.

[0049]Next, operation of the even number field in frame read-out is explained with reference to the timing chart of drawing 14 based on the explanatory view of drawing 15 of operation. First, since the potential under the transfer electrode 25 of the 2nd layer of the pixel which shifted from the case of the odd number field one line will become deep in a vertical blanking period if the vertical transfer clocks phiV3 are set to "H" level, The signal charge accumulated in the light-receiving field 12b of high sensitivity is read under the transfer electrode 25 at intervals of a pixel (t=t5). At this time, both the vertical transfer clocks phiV1, phiV2, phiV4, phiV5, and phiV6 are on the "L" level.

[0050]Then, the vertical transfer clocks phiV3, phiV4, and phiV5 change on the "L" level through the "M" level in order. That is, the vertical transfer clocks phiV3 change on ""M" level from H" level, and change on a fixed time of after "L" level further. Next, the vertical transfer clocks phiV4 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV3, and change on a fixed time of after "L" level further. Then, the

vertical transfer clocks phiV5 change on "L" "M" level from a level within the period of the "M" level of the vertical transfer clocks phiV4, and change on a fixed time of after "L" level further.
[0051]Thus, when the vertical transfer clocks phiV3, phiV4, and phiV5 change on the "L" level via the "M" level in order, vertical transfer of the signal charge under the transfer electrode 25 in which the vertical transfer clocks phiV3 were impressed is carried out. Since the vertical transfer clocks phiV6 were in the "M" level at this time, when the vertical transfer clocks phiV5 change on "M" "L" level from a level (t=t6), The signal charge transmitted from under the transfer electrode 25 in which the vertical transfer clocks phiV3 were impressed is moved under the transfer electrode 25 in which the vertical transfer clocks phiV6 were impressed, and is accumulated here.
[0052]Next, since the potential under the transfer electrode 26 of the 3rd layer of the pixel of the light-receiving field 12b of the high sensitivity read previously will become deep if the vertical transfer clocks phiV2 are set to "H" level, The signal charge accumulated in the light-receiving field 12a of the low sensitivity of the pixel concerned is read under the transfer electrode 26 (t=t7). At this time, both the vertical transfer clocks phiV1, phiV4, and phiV5 are in the "L" level, and both the vertical transfer clocks phiV3 and phiV6 are on the "M" level.
[0053]Since the potential under the transfer electrode 25 in which the potential and the vertical transfer clocks phiV3 under the transfer electrode 26 in which the vertical transfer clocks phiV2 were impressed were impressed will serve as the level if the vertical transfer clocks phiV2 are set to the "M" level, Signal-charge x read from the light-receiving field 12a of low sensitivity is stored under the transfer electrode 26 and the transfer electrode 25. And if the vertical transfer clocks phiV2 are set to the "L" level, the potential under the transfer electrode 26 will become shallow, and signal-charge x of the light-receiving field 12a of low sensitivity will be stored under the transfer electrode 25 (t=t8). Henceforth, it shifts to a line shift period and vertical transfer and horizontal transfer are performed like the case of an odd number field.
[0054]Drawing 16 is an outline lineblock diagram showing other embodiments of this invention, among the figure, gives identical codes to drawing 1 and an equivalent portion, and is shown. In drawing 16, each light sensing portion 1 by which two-dimensional arrangement was carried out becomes matrix form from the two light-receiving fields 12a and 12b where sensitivity differs, While mixing and carrying out vertical transfer of the signals of the light-receiving field of the sensitivity with same light sensing portion that adjoins each other among the signal charges read from each of the two light-receiving fields 12a and 12b for every light sensing portion within the vertical transfer register 2-1 - 2-n, Composition until it distributes to the two horizontal transfer registers 3 and 4 and carries out horizontal transfer independently by the distribution transfer gate 5 is completely the same as the case of a previous embodiment.
[0055]And it differs from the previous embodiment in that it states below. That is, in this embodiment, while forming the limiting circuit 61 beside the outgoing end part of the horizontal

transfer register 7 which carries out horizontal transfer of the signal charge of the light-receiving field 12b of high sensitivity, it has the composition of having formed the charge detector 62 and the buffer 63 in common to the two horizontal transfer registers 3 and 4. The signal charge of the light-receiving field 12a of the low sensitivity by which the charge detector 62 has floating diffusion amplifier composition, for example, and horizontal transfer was carried out with the horizontal transfer register 3, The signal charge of the light-receiving field 12b of the high sensitivity which horizontal transfer was carried out with the horizontal transfer register 4, and was clipped by the limiting circuit 61 is received, and both signal charges are mixed, and it changes and outputs to a signal level.

[0056]The Y-Y' line section of drawing 16 shows an example of the concrete composition of the limiting circuit 61 to drawing 17. In drawing 17, when the level CCD channel 65 is formed of the N type impurity layer formed in the surface side of the P type well region 64 and the horizontal transfer electrode 67 is allotted via the gate dielectric film 66 on it, the outgoing end part of the horizontal transfer register 4 is constituted. The outgoing end part of this horizontal transfer register 4 is adjoined, the drain 69 which consists of the overflow barrier 68 which consists of an N ^- type impurity layer, and an N type impurity layer is formed, and the limiting circuit 61 is constituted by this overflow barrier 68 and drain 69. The predetermined direct current voltage E0 is impressed to the drain 69.

[0057]In the limiting circuit 61 of the above-mentioned composition, the potential height of the overflow barrier 68 is decided by concentration of an N ^- type impurity layer, etc., and this potential height serves as a clip level with them. And when the signal charge of the light-receiving field 12b of high sensitivity is transmitted in order and accumulated in the packet beside the limiting circuit 61 in the horizontal transfer register 4, If the charge quantity exceeds a clip level, a limiting circuit will be hung to the signal charge of the light-receiving field 12b of high sensitivity by the electric charge to have exceeded being thrown away into the drain 69. In drawing 17, the direction of transfer of the horizontal transfer register 4 is a right-angled direction to space.

[0058]As mentioned above, in the CCD solid state camera concerning this embodiment. The inside of the signal charge read from each of the two light-receiving fields 12a and 12b for every light sensing portion, While mixing and carrying out vertical transfer of the signals of the light-receiving field of the sensitivity with same adjacent light sensing portion within the vertical transfer register 2-1 - 2-n, and the distribution transfer gate's 5 distributing to the two horizontal transfer registers 3 and 4 and carrying out horizontal transfer independently, By clipping by the limiting circuit 61 about the signal charge of the light-receiving field 12b of high sensitivity, and having made it mix with the signal charge of the light-receiving field 12a of low sensitivity by the floating diffusion capacity of the charge detector 62 after an appropriate time, Since a limiting circuit is hung by the common limiting circuit 61 to each signal charge of the light-

receiving field 12b of high sensitivity, it can control that originate in the characteristic variation between pixels and the nonuniformity of a fixed pattern occurs in a picture.

[0059]Although it had composition which hangs a limiting circuit to the signal charge of the light-receiving field 12b of high sensitivity within the horizontal transfer register 7 by the limiting circuit 61 in this embodiment, it is also possible to hang a limiting circuit to the signal charge of the light-receiving field 12b of high sensitivity within the charge detector 62.

[0060]Namely, while transmitting the signal charge of the light-receiving field 12a of low sensitivity, and the signal charge of the light-receiving field 12b of high sensitivity to the charge detector 62 by turns from the two horizontal transfer registers 3 and 4 in the form with which the high sensitivity side was made to precede, In the charge detector 62, as a reset pulse which resets floating diffusion capacity, What is necessary is to set up the ternary level containing a clamp level, to clip the signal charge by the side of the high sensitivity previously transmitted from the horizontal transfer register 4 with the clamp level, to mix with the signal charge by the side of the low sensitivity transmitted from the horizontal transfer register 3 after that, to change into a signal level, and just to make it output.

[0061]In each above-mentioned embodiment, although the case of composition of having divided each light sensing portion 1 into two to the light-receiving field to which sensitivity differs was explained, it is also possible to divide into three or more light-receiving fields to which it is not comparatively limited for 2 minutes, and sensitivity differs. In this case, since a horizontal transfer register also needs to transmit the signal charge corresponding to each sensitivity independently, only the number corresponding to the number of partitions of the light-receiving field is needed. If it hits hanging a limiting circuit, what is necessary is just made to carry out to signal charges other than the signal charge of the light-receiving field of figure of merit, or the signal based on it at least.

[0062]

[Effect of the Invention]As explained above, according to this invention, each light sensing portion is divided into several light-receiving fields to which sensitivity differs, The inside of the signal charge read from each of two or more light-receiving fields for every light sensing portion, While carrying out horizontal transfer of the signal charge of the light-receiving field which mixes and carries out vertical transfer of the signal charges of the light-receiving field of the sensitivity with same adjacent light sensing portion within a vertical transfer register and where sensitivity differs independently with two or more horizontal transfer registers, By having clipped signal charges other than the signal charge of the light-receiving field of figure of merit, or the signal based on it at least, mixing or adding and having made it output the signal charge of the light-receiving field of other sensitivity, or the signal based on it, A dynamic range can be expanded without generating the fixed pattern noise resulting from the nonuniformity of the saturation charge quantity Qs of each pixel, since a clamp is performed with a common clamp

level to each signal charge by the side of high sensitivity, or the signal based on it.

[Translation done.]